TECHNICAL BRIEFINGSHEET

Pure-Bore® Plus

The Drilling Fluid For A Cleaner Tomorrow

The most environmentally friendly, high performance drilling fluid system available.

Description

Pure-Bore® Plus is a CEFAS registered and Water Supply Regulations approved natural, biodegradable drilling fluid developed specifically for the Oil and Gas market, although can also be used in a wide variety of different drilling applications. A specially produced, dry, free flowing polymer, the Pure-Bore® Plus drilling fluid system provides exceptional borehole stability and cuttings removal in a wide range of ground conditions.

Rheology

Pure-Bore® Plus has been specially formulated to keep the pump pressure (annular pressure drop) as low as possible to minimise the risk of borehole break out whilst at the same time optimising hole cleaning. Whilst high shear rheology is a major factor in building high pump pressures and equivalent circulating densities (ECD's), it is the low shear (low flow rate viscosity) which is instrumental in providing efficient hole cleaning in horizontal boreholes at low annular flow rates.

Globally, Pure-Bore® Plus has been used very successfully on large, complex vertical and horizontal projects with very efficient hole cleaning. This is entirely due to the fact that Pure-Bore® Plus has been specifically developed to formulate an ultra efficient, highly stable, drilling fluid; building very high, low flow rate viscosity results (high 3rpm readings) to optimise hole cleaning. At the same time Pure-Bore® Plus builds a very flat rheology curve and the lowest possible high flow rate viscosity results (600rpm and 300rpm readings) to keep the pump pressure and risk of fluid loss as low as possible.

Pure-Bore® Plus versus PHPA Polymer rheology

The highly shear thinning Pure-Bore® Plus rheology curve has an added advantage in that it builds a drilling fluid which is easier to mix, pump and recycle on surface whilst also being more tolerant of drill solids.

Using Pure-Bore® Plus results in reduced product consumption, less down time associated with mixing and significant cost savings associated with lower dilution rates and reduced disposal quantities.

Sirius Gemstone
Plot # 150, Street # 09, Industrial area I 10-3, Islamabad
T +92-51-8446618-19 W www.gemstoneoiltools.com

TECHNICAL BRIEFING SHEET

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The Drilling Fluid For A Cleaner Tomorrow

Fluid Loss Control

Pure-Bore® Plus is unique as it produces a tight, firm filter cake in either a solids free, solids based, fresh water or salt water system. This unique ability helps provide exceptional borehole stability and reservoir protection whilst also making the Pure-Bore® Plus mud system very easy and simple to handle on site.

Typical API fluid loss figures for Pure-Bore® Plus mixed in clean fresh water at 5kg/m^3 are less than 15ml/30min dropping to less than 10ml/30min in the presence of a small quantity of drilled solids. Clear Stabiliser® and/or Calcium Carbonate added directly to the Pure-Bore® Plus mud system can reduce the API fluid loss to less than 2ml/30min.

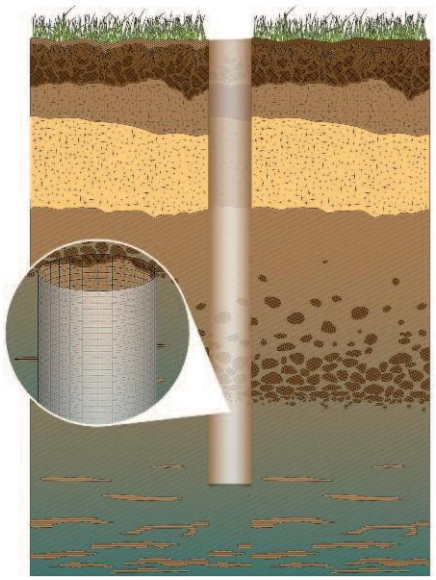
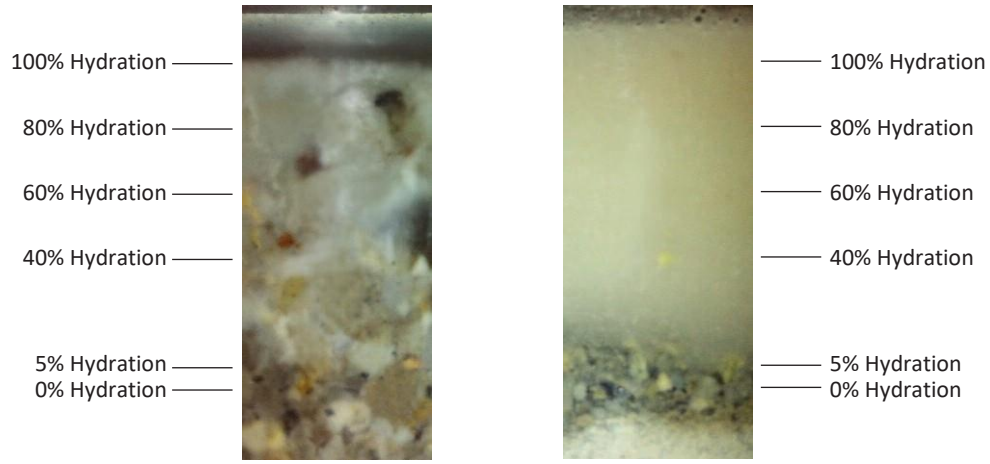


Diagram opposite: The Pure-Bore® Plus drilling fluid forms a thin but tight 'mesh-like' filter cake inside the borehole, protecting the formation from an ingress of fluids and solids.

Clay and Shale Inhibition

Pure-Bore® Plus provides exceptional clay and shale inhibition



100% Hydration after 24hrs **Max 5% Hydration after 24hrs**

The photographs above show two 250ml beakers each containing a 60g layer of ultra high yield, natural sodium montmorillonite (bentonite) clay granules. The left hand photograph shows the clay hydration 24 hours after fresh water was added to the granules. The right hand photograph shows the bentonite hydration 24 hours after Pure-Bore® Plus drilling fluid was added.

It can clearly be seen that the Pure-Bore® Plus drilling fluid exhibits exceptional clay and shale inhibition with the clay suffering virtually no swelling whilst the Pure-Bore® Plus drilling fluid has also effectively sealed the clay with very low fluid invasion through the unconsolidated, highly permeable granules.

Cuttings Recovery – 50g of the bentonite granules sized between 2 and 4mm were added to the Pure-Bore® Plus drilling fluid and hot rolled for 16 hours at 38°C (100°F). After hot rolling all cuttings exceeding 2mm were recovered for dry weight analysis. The bentonite clay granules totally dispersed into the fresh water and none were recovered – conversely 78% of bentonite granules were recovered from the Pure-Bore® Plus drilling fluid.

TECHNICAL BRIEFING SHEET

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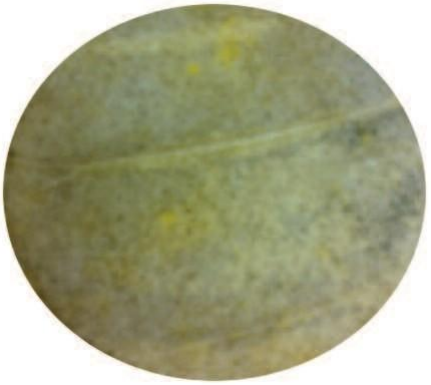
Reservoir Protection

Pure-Bore® Plus has the unique ability to build a tight firm filter cake even when mixed on its own in fresh or salt water. This characteristic provides very effective reservoir protection whilst drilling. The Pure-Bore® Plus filter cake very efficiently traps the drilled solids preventing them from entering the formation helping prevent irreversible formation damage.

The Pure-Bore® Plus filter cake is entirely biodegradable – this means that once the well is completed the Pure-Bore® Plus filter cake can be left to naturally degrade – as this occurs any trapped drilled solids fall back into the wellbore where they can be easily produced back out of the well – significantly improving production results/productivity.

The photographs below show a Pure-Bore® Plus filter cake from an actual coal bed methane well. The filter cake was left in clean fresh water with no agitation or movement to evaluate how long it took to fully degrade and disperse. The left hand photograph below shows the solids laden Pure-Bore® Plus filter cake (Pure-Bore® Plus mixed at 5kg/m^3 in the CBM drill water). The fluid loss was 8.5ml and a firm slick 1.5mm thick filter cake was deposited on the filter paper.



The right hand photograph shows the same filter cake left entirely unagitated/undisturbed in clean fresh water in a sealed container at ambient temperature (+/- 20°C) for a period of 8 weeks. After this period the Pure-Bore® Plus filter cake had broken down entirely leaving a clean filter with no trace of polymer or drilled solids (which had fallen away to the bottom of the test chamber) – the slight discolouring/grey staining on the filter paper is due to fact that the filter paper itself had started to degrade.

Reverse permeability testing - the baseline Pure-Bore® Plus drilling fluid (5 kg/m^3 Pure-Bore® Plus, 2 kg/m^3 Clear Stabiliser®, 20 kg/m^3 $CaCO_3$) was subjected to PPT at 38°C (100°F) and 500psi differential pressure using OFITE test equipment using (i) 60 micron 20 Darcy ceramic filter discs and (ii) 20 micron 5 Darcy ceramic filter discs.

Disc Permeability	30 min fluid loss
20 Darcy (60 µm)	8 ml
5 Darcy (20 µm)	6 ml

TECHNICAL BRIEFING SHEET

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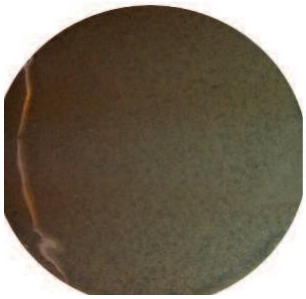
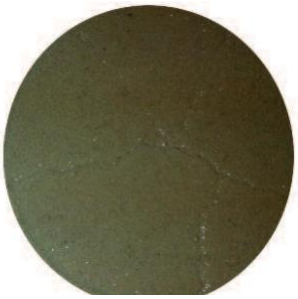
Reservoir Protection (continued)

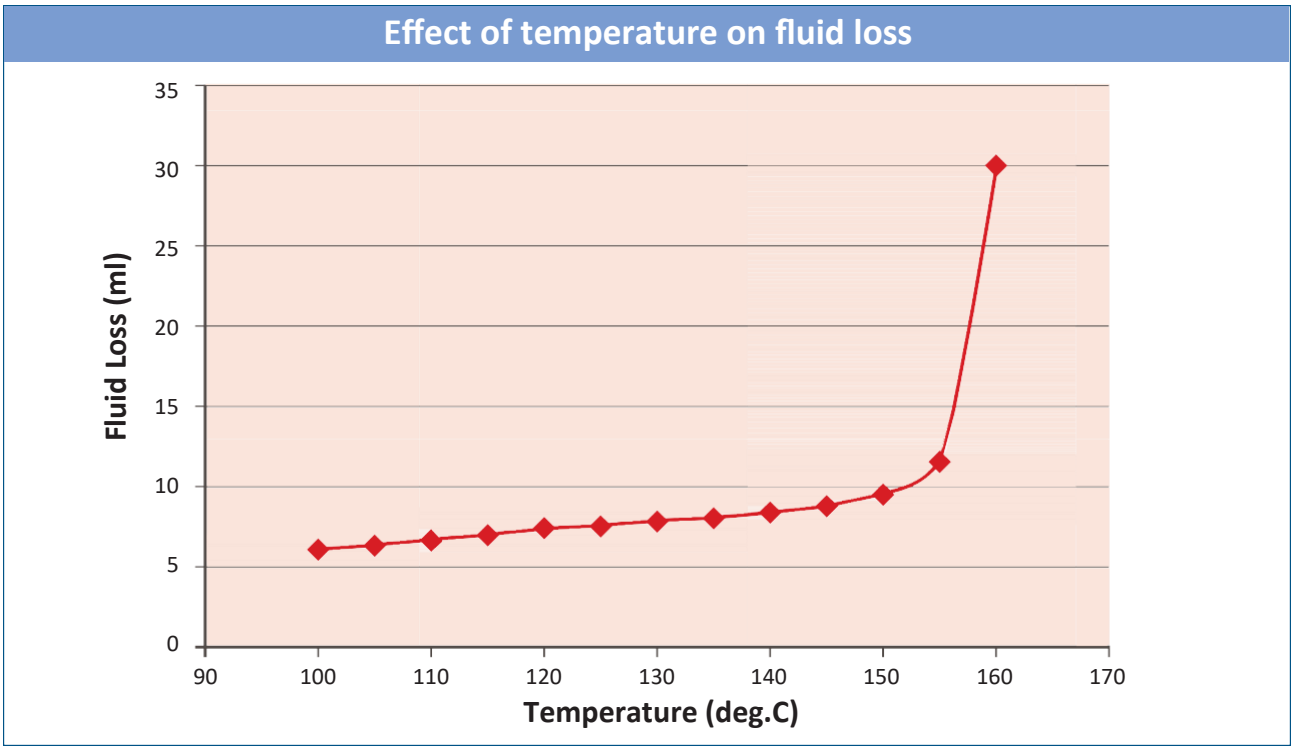
The left hand photograph below shows the Pure-Bore® Plus drilling fluid filter cakes on the ceramic discs. These discs were subsequently "soaked" in 200ml of 15% HCl for 12 hours (right hand photographs below) so that the discs could be re-tested to evaluate whether the filter cake was removable by acidisation.

BEFORE		AFTER	
			
20 DARCY	5 DARCY	20 DARCY	5 DARCY

The 20 and 5 Darcy discs were then retested using the RPT equipment using fresh water applied under pressure at ambient temperature. The water flowed straight through both discs at the same flow rate and differential pressure as that witnessed when using clean unused discs of the same permeability (40 - 45psi differential pressure) again demonstrating no associated formation damage when using Pure-Bore® Plus drilling fluid and the ability of using 15% HCl solution to rapidly break down the filter cake.

Thermal Stability

Pure-Bore® Plus is extremely heat stable and works very effectively at temperatures up to and including 130°C. The graph below shows the typical Pure-Bore® Plus fluid loss versus temperature.



TECHNICAL BRIEFING SHEET

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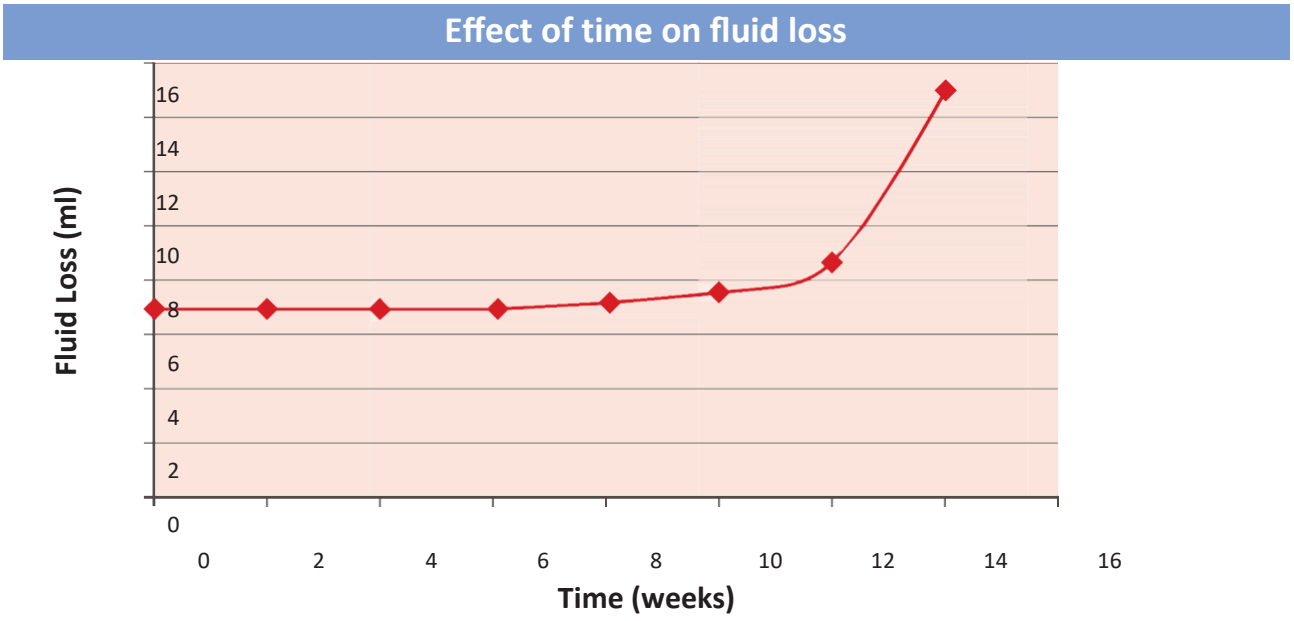
Fermentation Stability

Whilst Pure-Bore® Plus is entirely biodegradable over time - in the short term and in use it is extremely resistant to microbiological degradation. The graph below shows the typical Pure-Bore® Plus fluid loss versus time.



Resistance to HCl Clean Up Fluid

When the base line Pure-Bore® Plus fluid is treated with HCl it is effectively destroyed. When mixed as a 1:1 ratio with 15% HCl:

	7½ min spurt loss	30 min fluid loss
After 1 hour	30 ml	10 ml
After 12 hours	-	100% loss

After 1 hour, the $CaCO_3$ solids have become soluble and the Pure-Bore® Plus/Clear Stabiliser® started to degrade. After 12 hours, the Pure-Bore® Plus/Clear Stabiliser® fully degraded.